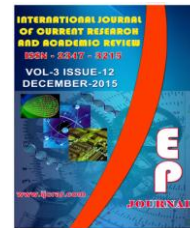




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Structural Analysis of Gangavara Reserve Forests of Kodagu, Karnataka, India

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A B S T R A C T

For this research work, Gangavara Reserve Forest (a moist deciduous forest) of Shanivarasanthe Range, Kodagu district, Karnataka was sampled. It was evaluated by its structure and floristic composition through Point Centered Quarter method (PCQ). A total of 25 plant species belonging to 18 families were encountered. The present study provides basic information about floristic composition of the reserve forest as well as species conservation status. As per phytosociological analysis, plant species composition, basal area, height, density, frequency, dominance, IVI and FIV were determined. Gangavara reserve forest is predominately occupied by *Lagerstroemia lanceolata* and *Pterocarpus marsupium*, these plant species make the forest as a moist deciduous type.

Introduction

Kodagu district is situated on the southwest tip of Karnataka state and the tract lies between 11055 and 12050 north latitude, 75020 and 76015 east longitude. The tract has mountainous configuration presenting a grand panorama of valleys, ravines, peaks and spurs. The forest which is situated in different slopes and aspects plays an important role in distribution of the species. The average rainfall of the district is 2725mm. Rainfall decreases from west to east due to the hilly terrain. The nature of vegetation greatly varies from

Bhagamandala receiving 6000mm of rainfall to Kushalnagar which receives 1100mm of rainfall annually. The forest of kodagu which belongs to Western Ghats is confined to the hilly region. Depending upon the Phenological condition and other ecological factors, the forest is divided into moist and dry type. The moist forest can be further subdivided into wet evergreen, semi evergreen and moist deciduous. The dry type can be subdivided into dry deciduous and thorn forest. In moist deciduous forest, species remain deciduous only for a short

time were number of evergreen dominates are present in the under storey. The general nature of the forest is deciduous and there are semi deciduous species in the upper canopy. The under growth has bamboo in open and canes on wet ground. In moist deciduous forest, trees become leafless during March to April and before the monsoon sets in, most of trees get back the foliage. Fire is serious problem in the deciduous belt of the kodagu where there is substantial accumulation of leaf litter on the forest floor (Ajay Misra, 2008). As there were no reports on the floristic analysis of Gangavara reserve forest, the present study attempts to reveal the structure of the moist deciduous forest.

Materials and Methods

Gangavara forest is a reserve forest which covers an area of 111.57 hectares. It is located 12^o42'-North and 075^o56' East of Shanivarasanthe Range with an altitude of 1040 meter above sea level. It has annual rain fall of 1694 mm and a mean temperature of 20.8 °C during winter and 25.6 °C during summer.

A 1000 meter transect (Line) was established through the habitat. At regular intervals of 100 meter, transect points were demarcated. At each point, an imaginary line was drawn perpendicular to the transect thereby creating four quadrates. In each of the quadrates, the closest single living plant with a GBH \geq 5cm was identified taxonomically (Keshavamurty and Oganarasimhan, 1990), distance from the point to each of four trees was measured; GBH and Total height were taken (Cottam and Curtis 1956; Gibbs et al 1980; Cavassan et al. 1984; Krebs 1989; Dias et al. 1992 and Sparks et al. 2002).

The phytosociological data viz. basal area, relative densities, relative frequency, relative dominance, IVI and FIV, the index of diversity viz. Simpson index and Shannon index were determined. (Krebs, 1989; Shivaprasad et al. 2002 and Vasanthraj&Chandrashekar, 2006).

Data Analysis

GBH and Height Classes of number of individuals of different species were calculated. The density, basal area, dominance, frequency, Importance value index (IVI) and Family Importance Value (FIV) were calculated (Pascal, 1988).

The density (ni) of each species was recorded by counting the total number of individuals. The Dominance (d) was determined by the basal area (at 1.3m height) of individuals of the same species.

1. The Relative frequency (RFi) was determined by using the formula

$$RFi = AFi / TF \times 100$$

Where AFi=Absolute frequency of species and TF = Total Frequency (Sum of AFi)

2. Relative density (RDi) was determined by using the formula

$$RDi = ADi / AD \times 100$$

Where ADi = Absolute density of species and AD = Absolute density

3. Relative Dominance or Cover (RCi) was determined by using the formula

$$RCi = BAi / TBA \times 100$$

Where BAi = Basal area of species and TBA = Total basal area

4.Importance Value Index of a species were calculated by adding The Relative frequency (RFi), Relative density (RDi) and Relative dominance(RCi).The Family Importance

Value Index (FIV) for botanical families were calculated by adding the IVI for different species of the same family. The floristic diversity was measured by using Simpson's index.

$$D=1-\sum_{i=1}^s (ni/N)^2$$

Where ni = number of individuals of species
N= total number of individuals in the plot
and

S=number of species in the plot

Shannon-Wieners index

$$1) H' = 3.3219(\log_{10} N - 1/N \sum_{i=1}^S ni \log_{10} ni)$$

i=1

Where ni, N and S are the same as in Simpson's index and

3.3219 is the conversion factor from log₂ to log₁₀

$$2) H_{max} = 3.3219 \log_{10} S$$

Results and Discussion

Floristic Composition

A total of 25 species belonging to 18 families were found, among the families Fabaceae, Boraginaceae, Sapindaceae, Combretaceae, Anacrdiaceae, Euphorbiaceae, Moraceae and Delliniaceae were represented by two species and Lythraceae, Delliniaceae, Bignonaceae Ebenaceae, Malvaceae, Myrtaceae, Flaucourtiaceae, Verbaenaceae, Meliaceae, Cannabaceae, Rubiaceae were monospecific. (Table-1). According to the data most of the families distributed equally. Undergrowth was represented by Canes, Reeds, creepers and Climbers such as *Cycleapeltata*, *Acacia sinuata*, *Jasminum malabaricum*, and *Piper nigrum* (wild), *Bambusa bamboo*, *Calamus pseudotenuis*,

Calamus rheedii and *Macaranga roxburghii*.

Importance Value Index (IVI)

The IVI of the *Lagerstroemia lanceolata*(43.39) was highest in this forest and followed by *Pterocarpus marsupium* (33.55), *Redermachera xylocarpa* (27.48), *Dillenia indica* (25.86) and *Cordiamixa* (21.26). *Sapinduse merginatus*, *Lanneacoro mondalica*, *Terminalia alata* and *Diospiros montana* were showed value ranging between 10-15. The rest of the species showed IVI less than 10 (Table-2). The FIV of Lythraceae was high (43.38) followed by Fabaceae (39.72) Bignonaceae (27.48) and Boraginaceae (26.33). The Family Lythraceae showed high FIV and a single species i.e. *Lagerstroemia lanceolata* showed high IVI indicating its dominance.

Table.1

Name of the Family	Number of species
Fabaceae	2
Lythraceae	1
Delliniaceae	1
Boraginaceae	2
Bignonaceae	1
Sapindaceae	2
Combrataceae	2
Anacrdiaceae	2
Euphorbiaceae	2
Ebenaceae	1
Malvaceae	1
Moraceae	2
Myrtaceae	1
Flaucourtiaceae	1
Verbaenaceae	1
Meliaceae	1
Cannabaceae	1
Rubiaceae	1

Density

Absolute density of the study area is 1018.3 Individuals /hectare. The members of Fabaceae, Lythraceae and Delliniaceae accounted same value i.e. 11.25% of the total individual's.

Among these family Lythraceae and Delliniaceae were monospecific, *Lagerstroemia lanceolata* and *Dilleniaindica* showed same density (11.25%), Fabaceae family represented by two species *Pterocarpus marsupium*(8.75%) and *Albiziaaoda ratissima* (2.5%), so Lythraceae and Delliniaceae were considered as dominant families.

Other than above mentioned species *Redermachera xylocarpa* (10%) was considered second dominate species and the remaining species showed less than 10% (Table-2). According to data the plotted area was predominated by *Lagerstroemia lanceolata* and *Dilleniaindica*.

Basal Area

The total basal area was 93.200 m²/ hectare, of which a Lythraceae member i.e. *Lagerstroemia lanceolata* alone constituted 19.59% of the total basal area and Fabaceae member *Pterocarpus marsupium* showed 15.35% in the plotted area, the rest of the species had less than 10%.(Table-2).

Along the transect *Lagerstroemia lanceolata* and *Pterocarpus marsupium* were occupied more space than other species in an evaluated area. *Lagerstroemia lanceolata* showed simultaneously high density with high basal area value hence it occupied major portion of the sampled area.

Height and GBH Classes

Nearly 57.5% of the individuals were within 0-8m height range, 37.5% of the individuals belonged to the class of 8-16 height. Only 5% of the individuals were exceeded 16m. height Among the species *Tremaorientalis*, *Pterocarpus marsupium* and *Terminalia alata* were occupied in the upper storey and *Lagerstroemia lanceolata*, *Terminalia bellerica* and *Redermachera xylocarpa*etc. were in middle storey of the forest. (Table - 4).

63.75% of the individuals belonged to 10-120 cm GBH class and 31.25% of the individuals belonged to 120-240 GBH range, only 5% belonged to 200cm range, among them 50% of the individuals were *Pterocarpus marsupium*, 25% *Lagerstroemia lanceolata* and 25% *Terminalia alata* (Table -5). Based on height and GBH classes, nearly 60% of the individuals of the forest represented set of the future, nearly 35% represented set of the present and nearly 5% represented set of the past .This indicated that the forest is of rejuvenating type.

Floristic Richness

The high value for Simpson index (0.93) indicated that out of every 100 pairs of individuals taken randomly, 7 belong to same species that revealed high floristic richness of the forest. The lower N/S ratio of plot (3.2) suggested that the number of individuals of the species in plot was less. High Shannon- Wiener's index ($h' = 2.924$) indicated moderate representation of most of the species in the forest (Table-6). Diversity indices revealed the relatively high diversity in the forest.

Table.2

	Species i	ni	ADi	RDi	Ji	AFi	RFi	BAi	MBAi	ACi	RCi	IVI
1	<i>Albizziadar atissima</i>	2	25.46	2.5	2	10	2.78	0.84	0.42	0.0011	0.89	6.172
2	<i>Lagerstroemia lanceolata</i>	9	114.55	11.25	8	40	11.11	19.59	2.17	0.024	21.020	43.38
3	<i>Mallotus philipensis</i>	2	25.45	2.5	2	10	2.77	2.041	1.020	0.0026	2.189	7.467
4	<i>Trema orientalis</i>	1	12.72	1.25	1	5	1.39	1.77	1.77	0.00224	1.895	4.534
5	<i>Sapindus emerginatus</i>	5	63.64	6.25	5	25	6.94	1.872	0.374	0.00238	2.009	15.20
6	<i>Ficus infectoria</i>	1	12.73	1.25	1	5	1.388	2.268	2.268	0.00288	2.434	5.073
7	<i>Cordia mixa</i>	7	89.10	8.75	5	25	6.94	5.19	0.74	0.0066	5.571	21.266
8	<i>Redermacheraxylocarpa</i>	8	101.83	10	6	30	8.333	8.532	1.066	0.0108	9.155	27.488
9	<i>Pterocarpus marsupium*</i>	7	89.101	8.75	6	30	8.333	15.35	2.192	0.0195	16.47	33.55
10	<i>Lanneacoro mondalica</i>	4	50.915	5	4	20	5.555	2.845	0.711	0.0036	3.053	13.608
11	<i>Dillenia indica</i>	9	114.55	11.25	8	40	11.11	3.261	0.3624	0.0041	3.499	25.860
12	<i>Terminalia bellerica</i>	2	25.457	2.5	2	10	2.777	2.080	1.040	0.00264	2.232	7.509
13	<i>Schleicheraoleosa</i>	2	25.457	2.5	2	10	2.777	1.352	0.676	0.00172	1.4508	6.728
14	<i>Cordia macleodii</i>	1	12.728	1.25	1	5	1.388	2.268	2.268	0.00288	2.434	5.0730
15	<i>Vite xaltissima</i>	1	12.728	1.25	1	5	1.388	1.766	1.766	0.0022	1.895	4.534
16	<i>Mangifera indica</i>	1	12.728	1.25	1	5	1.388	4.906	4.906	0.00624	5.264	7.903
17	<i>Kydia calycina</i>	3	38.18	3.75	3	15	4.166	0.949	0.316	0.0012	1.0191	8.935
18	<i>Terminalia alata</i>	3	38.186	3.75	2	10	2.777	5.999	1.999	0.0076	6.437	12.964
19	<i>Diospiros montana</i>	3	38.18	3.75	3	15	4.166	2.716	0.905	0.0034	2.914	10.830
20	<i>Scolopiacrenata</i>	2	25.45	2.5	2	10	2.77	1.022	0.511	0.0013	1.096	6.374
21	<i>Canthium parviflora</i>	1	12.72	1.25	1	5	1.388	0.158	0.158	0.0002	0.170	2.809
22	<i>Aporosal indleyana</i>	2	25.45	2.5	2	10	2.777	0.321	0.160	0.0004	0.345	5.623
23	<i>Syzygium cumini</i>	2	25.45	2.5	2	10	2.777	2.576	1.288	0.0032	2.764	8.042
24	<i>Ficus tsiela</i>	1	12.72	1.25	1	5	1.388	2.009	2.009	0.0025	2.156	4.795
25	<i>Cedrelatoona</i>	1	12.728	1.25	1	5	1.388	1.514	1.514	0.0019	1.624	4.263
	Total	80	1018.3	100		TF=360	99.97	TBA=93.200		TC=0.118632	99.99	299.98

Table.2 ni=number of individuals, ADi=absolute density, RDi=relative density, Ji=number of quadrates in which sps. is present, AFi=absolute frequency, RFi=relative frequency, BAi=basal area, MBAi=Mean basal area ,ACi=absolute cover/dominance, RCi=relative cover/dominance, IVI=importance value index

*Threatened species

Table.3

Family	FIV
Fabaceae	39.726
Lythraceae	43.382
Delliniaceae	25.860
Boraginaceae	26.33
Bignonaceae	27.488
Sapindaceae	21.92
Combretaceae	20.46
Anacrdiaceae	21.511
Euphorbiaceae	13.09
Ebenaceae	10.830
Malvaceae	8.935
Moraceae	9.868
Myrtaceae	8.042
Flaucourtiaceae	6.374
Verbaenaceae	4.534
Meliaceae	4.263
Cannabaceae	4.534
Rubiaceae	2.809

Table.4

HeightClass(m)	No of Individuals	Percentage
0-4	12	15
4-8	34	42.5
8-12	20	25
12-16	10	12.5
16-20	3	3.75
20-24	0	0
24-28	1	1.25

Table.5

Girth Range (cm)	No of individuals	Percentage
10-40	3	3.75
40-80	24	30
80-120	24	30
120-160	15	18.75
160-200	8	10
200-240	2	2.5
240-280	4	5.0
280-320	0	0
320-360	0	0

Conclusion

In Gangavara Reserve Forest, *Lagerstroemia lanceolata* and *Dillenia indica* showed high relative frequency and high relative density, *Lagerstroemia lanceolata* showed very high relative dominance (21.02) hence IVI was maximum (43.38) thus revealing that *Lagerstroemia lanceolata* occupied most of the sampled area; they were turned to be the most important species within the community. *Dilleniaindica* showed low relative dominance and IVI, so *Pterocarpus marsupium* was considered as the second important species in the forest (relative dominance and IVI were high compared to *Dilleniaindica*). Gangavara RF is occupied by 25 different species, all are represented in few numbers hence the forest has maximum diversity as well as it is regenerating type compared to other forests of kodagu district.

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